Case Study: North Dakota
Using FAF Data in Economic Analysis
June 26, 2014

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North Dakota State University, Fargo, ND
Agenda

• Background
• Objective of the case study
• Economic analysis and FAF
• Understanding FAF
• Why FAF?
• Incorporating FAF
• Results
• Q & A
Background

- Boom of oil & gas industries, changes of agricultural logistics pattern, and increase of other baseline traffic
- Road infrastructure needs for a 20-year planning horizon
- Needs for travel demand modeling (TDM) and economic analysis
Objective of the Case Study

• To support NDDOT and Counties to identify current and future needs

• Tasks
  – To quantify freight flows for commodities on major highways and local roads
  – To forecast future highway capacity
  – To estimate investments needs
Needs for Statewide Modeling

- Funnel of Dynamic Economic Activities
  - Increasing complexity
Importance of Economic Analysis

- Critical rural freight corridors for goods movement
- Financial constraint
- Deteriorated and insufficient infrastructure for energy and agricultural logistics and economic activities

- Using FAF Traffic Data
  - Benefit Cost Analysis (BCA)
  - Life-Cycle Cost Analysis (LCCA)
Economic Analysis Process

Overview

Engineering Standards
Deficiency Standards
Benchmark Unit Cost
User Cost
Treatment

Highway Inventory
Capacity
NDDOT/UGPTI Network

Traffic Forecasting
(intermediate year file)

Cost and Treatment

Road Network

Traffic Volume

Benefit-Cost Analysis

Life-Cycle Cost Analysis

Source: HERS-ST User Guide9
State Traffic Model

• Intra-zonal Movement
  – UG PTI Report from www.ugpti.org
Traffic Flow in FAF

- Inbound (E-I)
- Local Truck Traffic (I-I)
- Outbound (I-E)
- Through traffic (E-E)

Data Sources
- Non-FAF
- FAF
What FAF does and does NOT do

• What the FAF does
  – Indicates states’ and localities’ major trading partners, plus volumes and sources of traffic passing through their jurisdictions at corridor level
  – Shows truck tonnage and number of trucks on the network, particularly in regions with multiple routes or significant local traffic between major centers of freight activity

• What the FAF does NOT
  – Show local detail or temporal variation in freight flows
  – Provide local data to support local applications
Things To know About FAF3

- **Geographic regions**
  - Single TAZ in North Dakota

- **Network**
  - Centerline without considering directions for divided highways and one-way traffic
  - Not designed for the purpose of routing
  - Primary freight network and critical rural freight corridors (no local roads)

- **Attributes**
  - No road condition / No pavement type

- **Adjustment**
  - Coarse space and time
Things To know About FAF3

- Geographic regions (FAF Zone)


Figure 2.1 FAF$^3$ Geography

Things To know About FAF3

- Comparison of FAF and state networks
Why FAF?

- Comprehensive freight movements
- Multimodal infrastructure
- Authoritative
- Affordable
- Easy to use
Freight Analysis Framework Data Tabulation Tool

**Total Flows**

This option is provided for users interested in tabulating FAF² data to examine total flows moved between domestic origins and destinations and includes both domestic and foreign shipments. For import shipments, the origin of the flow is the zone (state or region) of entry, and for export shipments the destination of the flow is the zone (state or region) of exit. Mode of transportation for this tabulation is the mode used from zone of entry to the domestic destination, domestic origin to domestic destination, and domestic origin to zone of exit.

Note: The units of measure for 1997, 2002, 2007, and 2015-2040 data are thousands of tons for weight, millions of 2007 dollars for value, and millions for ton-miles. Provisional Annual Data for the most recent year are presented in both millions of 2007 dollars and millions of current dollars (Current $).

### Year | Origin | Destination
--- | --- | ---
1997 | New Hampshire | Select all FAF zones
2002 | New Jersey | Birmingham AL CSA
2007 | New Mexico | Mobile AL CSA
2012 | New York | Remainder of Alabama
2015 | North Carolina | Alaska
2020 | North Dakota | Phoenix AZ MSA
2025 | | |

### Measure | Commodity | Domestic Mode
--- | --- | ---
Select All | 10 Building stone | Combine total (no specific Info)
Tons | 11 Natural sands | 1 Truck
Ton-Mile | 12 Gravel | 2 Rail
Values | 13 Nonmetallic minerals | 3 Water
 | 14 Metallic ores | 4 Air (include truck-air)
 | 15 Coal | 5 Multiple modes & mail
 | 16 Crude petroleum | |

**DMS ORIG**

<table>
<thead>
<tr>
<th>DMS_DEST</th>
<th>SCTG2</th>
<th>DMS_MODE Total K tons in 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Dakota Denver CO CSA</td>
<td>Crude petroleum Truck</td>
<td>10.81</td>
</tr>
<tr>
<td>North Dakota Chicago IL-IN-WI CSA (IL Part)</td>
<td>Crude petroleum Truck</td>
<td>0.00</td>
</tr>
<tr>
<td>North Dakota Iowa</td>
<td>Crude petroleum Truck</td>
<td>0.00</td>
</tr>
<tr>
<td>North Dakota Remainder of Kansas</td>
<td>Crude petroleum Truck</td>
<td>4.37</td>
</tr>
<tr>
<td>North Dakota Minneapolis-St. Paul MN-WI CSA (MN Part)</td>
<td>Crude petroleum Truck</td>
<td>10.23</td>
</tr>
<tr>
<td>North Dakota Remainder of Minnesota</td>
<td>Crude petroleum Truck</td>
<td>0.00</td>
</tr>
<tr>
<td>North Dakota Montana</td>
<td>Crude petroleum Truck</td>
<td>56.73</td>
</tr>
<tr>
<td>North Dakota Nebraska</td>
<td>Crude petroleum Truck</td>
<td>0.00</td>
</tr>
<tr>
<td>North Dakota North Dakota</td>
<td>Crude petroleum Truck</td>
<td>17.96</td>
</tr>
<tr>
<td>North Dakota South Dakota</td>
<td>Crude petroleum Truck</td>
<td>1.14</td>
</tr>
<tr>
<td>North Dakota Remainder of Wisconsin</td>
<td>Crude petroleum Truck</td>
<td>0.00</td>
</tr>
<tr>
<td>North Dakota Wyoming</td>
<td>Crude petroleum Truck</td>
<td>63.04</td>
</tr>
</tbody>
</table>
Data Download

FAF[^ Network Database and Flow Assignment: 2007 and 2040

The Freight Analysis Framework (FAF) estimates commodity movements by truck and weight for truck-only, long distance moves over specific highways. Models are used to disaggregate interregional flows from the Origin-Destination Database into flows between localities andto assign those flows to individual highways using average payloads per truck, and truck counts on individual highway segments. Using route number and milepost, functional classification of the highway, number of lanes, and other highway characteristics for individual highway links, truck tonnage is assigned to the network segments. Models used to disaggregate flows are based on geographic distributions of economic activity rather than a detailed understanding of local conditions and the resulting network flows should not be used as a substitute for local data to support local planning and project development.

Network Data

If you have GIS software, download the network and boundary layers that correspond to your GIS software:

- **Network**
  - ESRI Format (shapefile): faf3_4_esri.zip [Zip 39MB]
  - TransCAD Format: faf3_4_transcad.zip [Zip 55MB]
  - Metadata [HTML PDF 39KB]

- **FAF[^ Regions Boundary Layer**
  - ESRI Format (shapefile): faf3_zone_esri.zip (shapelie) [Zip 25MB]
  - TransCAD Format: faf3_zone_transcad.zip [Zip 12MB]

To use the results in software other than GIS, download the FAF Output database file.

- **FAF Output**
  - faf3_data.dbl [53MB]
  - Data Dictionary [HTML PDF 23KB]

PDF files can be viewed with the Acrobat Reader®.

If you need a version of a Zip extracting tool, you may use WinZip® as an option.
Data Download

**FAF³ Network Database and Flow Assignment: 2007 and 2040**

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- **FAF Output**
  - `fa34_data.dbf` [53MB]
  - Data Dictionary [HTML, PDF 23KB]

PDF files can be viewed with the Acrobat® Reader®

If you need a version of a Zip extracting tool, you may use WinZip® as an option.
### FAF – Data Dictionary

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Domain Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Integer</td>
<td>Unique identifier to link with FAF network arcData field</td>
</tr>
<tr>
<td>Version</td>
<td>Character</td>
<td>Used for maintaining consistency across data files containing alternate releases of the FAF.</td>
</tr>
<tr>
<td>State</td>
<td>Character</td>
<td>State abbreviation</td>
</tr>
<tr>
<td>County Code</td>
<td>Integer</td>
<td>County Code</td>
</tr>
<tr>
<td>State Route</td>
<td>Character</td>
<td>State Route Sign</td>
</tr>
<tr>
<td>Unique State Route</td>
<td>Character</td>
<td>Unique State Route Nail</td>
</tr>
<tr>
<td>Real Start</td>
<td>Real</td>
<td>Start of service milepost</td>
</tr>
<tr>
<td>Real End</td>
<td>Real</td>
<td>End of service milepost</td>
</tr>
<tr>
<td>AADT</td>
<td>Integer</td>
<td>HDMT: annual average daily traffic for year 2001, derived from HCM 2000 database. Volume/day/route</td>
</tr>
<tr>
<td>AADTT</td>
<td>Integer</td>
<td>Year 2007 Average Truck Volume estimated using a combination of HCM 2000 database, state truck percentage, and functional class specific defaults. Volume/day/route</td>
</tr>
<tr>
<td>FYAF</td>
<td>Integer</td>
<td>FAF 3.4 long distance truck volume estimated based on the FAF 3.4 Origin-Destination truck tonnage and includes empty trucks. Volume/day/route</td>
</tr>
<tr>
<td>NONFAF40</td>
<td>Integer</td>
<td>Local truck traffic that is not part of FAF 3.4 O-D database. Volume/day/route</td>
</tr>
<tr>
<td>Forecast</td>
<td>Integer</td>
<td>Forecast Annual Average Truck Volume estimated using the HCM 200 years growth factors and projected to future using linear growth. Volume/day/route</td>
</tr>
<tr>
<td>FAF40</td>
<td>Integer</td>
<td>Year 2040 FAF 3.4 long distance truck volume estimated based on the forecasted FAF 3.4 Origin-Destination truck tonnage and includes empty trucks. Volume/day/route</td>
</tr>
<tr>
<td>NONFAF40</td>
<td>Integer</td>
<td>Year 2040 Local truck traffic that is not part of FAF 3.4 O-D database. Volume/day/route</td>
</tr>
<tr>
<td>Car</td>
<td>Integer</td>
<td>Link specific peak capacity estimated using the procedures outlined in HCM 2000 and the arc geometry provided in 2003 HCM database. Volume/day/route</td>
</tr>
<tr>
<td>SF07</td>
<td>Integer</td>
<td>Estimated service flow using the procedures outlined in HCM 2000 and arc geometry, FAF truck, non-FAF truck and passenger volume.</td>
</tr>
</tbody>
</table>
FAF3.4 Freight: Growth

AADTT (Average Annual Daily Truck Traffic)
FAF3 - Traffic Growth

- Missing Annual Traffic Growth
  - FAF07 and
  - ??? (FAF08, FAF09, ……FAF30, …, FAF39)
  - FAF40

- Assumption to use FAF traffic for ND Model
  - Using Primal Highways for long distance
Example – Interpolating: FAF
Example – Interpolated: FAF
Hybrid

- Intra-zonal traffic & Inter-zonal Traffic
Hybrid

- Growth Rate Within the State: Non-Linear
- Growth Rate of FAF07-40: Linear

Projected AADT for 2014~2032 by 2 years
Results

Investment Needs for the Funding Periods

- Average Daily Trips (ADT)
- Average Daily Truck Trips (ADTT)
- Truck Type and Axle Configuration
- Structural Number (SN)
- Cumulative ESALs
- Existing Pavement Structure
- Present Serviceability Rating (PSR)
- Oil Module (MR)
- Maximum Feasible Life with no truck traffic
- Graded Width

Table C: Summary of All Road Investment and Maintenance Needs for Counties and Townships in North Dakota (Millions of 2012 Dollars)

<table>
<thead>
<tr>
<th>Period</th>
<th>Oil Producing Counties</th>
<th>Rest of State</th>
<th>Statewide Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-2014</td>
<td>$321</td>
<td>$311</td>
<td>$334</td>
</tr>
<tr>
<td>2015-2016</td>
<td>$399</td>
<td>$382</td>
<td>$781</td>
</tr>
<tr>
<td>2017-2018</td>
<td>$306</td>
<td>$397</td>
<td>$703</td>
</tr>
<tr>
<td>2019-2020</td>
<td>$321</td>
<td>$379</td>
<td>$700</td>
</tr>
<tr>
<td>2021-2022</td>
<td>$310</td>
<td>$366</td>
<td>$647</td>
</tr>
<tr>
<td>2023-2024</td>
<td>$1,576</td>
<td>$1,038</td>
<td>$2,204</td>
</tr>
<tr>
<td>2013-2015</td>
<td>$3,404</td>
<td>$3,495</td>
<td>$6,979</td>
</tr>
</tbody>
</table>

* Results may not sum due to rounding.

Source: www.ugpti.org
Results

Investment Needs for the Funding Periods

<table>
<thead>
<tr>
<th>Period</th>
<th>Oil Producing Counties</th>
<th>Rest of State</th>
<th>Statewide Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-2014</td>
<td>$521</td>
<td>$311</td>
<td>$834</td>
</tr>
<tr>
<td>2015-2016</td>
<td>$389</td>
<td>$382</td>
<td>$772</td>
</tr>
<tr>
<td>2017-2018</td>
<td>$366</td>
<td>$397</td>
<td>$763</td>
</tr>
<tr>
<td>2019-2020</td>
<td>$321</td>
<td>$379</td>
<td>$700</td>
</tr>
<tr>
<td>2021-2022</td>
<td>$310</td>
<td>$336</td>
<td>$647</td>
</tr>
<tr>
<td>2023-2032</td>
<td>$1,576</td>
<td>$1,688</td>
<td>$3,324</td>
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<tr>
<td>2013-2032</td>
<td>$3,484</td>
<td>$3,495</td>
<td>$6,979</td>
</tr>
</tbody>
</table>

* Results may not sum due to rounding.

By Funding Period and Road Type (millions of 2012 dollars)

<table>
<thead>
<tr>
<th>Road Type</th>
<th>2013-2014</th>
<th>2015-2016</th>
<th>2013-2032</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpaved</td>
<td>$471</td>
<td>$471</td>
<td>$5,033</td>
</tr>
<tr>
<td>Paved</td>
<td>$363</td>
<td>$301</td>
<td>$1,946</td>
</tr>
<tr>
<td>Total Statewide</td>
<td>$834</td>
<td>$772</td>
<td>$6,979</td>
</tr>
</tbody>
</table>

Source: www.ugpti.org
Results

Estimated Funding Required for the Funding Periods

<table>
<thead>
<tr>
<th>Road Type</th>
<th>2013-2014</th>
<th>2015-2016</th>
<th>2013-2032</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpaved</td>
<td>$471</td>
<td>$471</td>
<td>$5,035</td>
</tr>
<tr>
<td>Paved</td>
<td>$383</td>
<td>$961</td>
<td>$1,846</td>
</tr>
<tr>
<td>Total Statewide</td>
<td>$854</td>
<td>$772</td>
<td>$6,879</td>
</tr>
</tbody>
</table>

Source: www.ugpti.org
FAF & Road Investment Planning

- FAF outputs:
  - Yearly or biennial traffic flows
  - Directional flows for major highways and rural freight corridors

- Implication: road investments needed
Summary

• Demonstrated how FAF is used for Economic Analysis
• Demonstrated the process of combining local traffic and FAF traffic
• Discussed the components to improve for the future FAF
Thanks for your Attention!

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701-231-6448